



P-ISSN: 2349-8528  
 E-ISSN: 2321-4902  
 IJCS 2018; 6(1): 1853-1856  
 © 2018 IJCS  
 Received: 06-11-2017  
 Accepted: 07-12-2017

**Malashri**  
 Department of Horticulture  
 University of Agricultural Sciences Dharwad, Karnataka, India

**Shashidhar TR**  
 Department of Horticulture  
 University of Agricultural Sciences Dharwad, Karnataka, India

## Impact of planting methods and clove size on growth, yield and economics of garlic (*Allium sativum L.*) during *kharif* season

**Malashri and Shashidhar TR**

### Abstract

A field experiment was conducted at Saidapur Farm, Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, on different planting methods and clove size on growth and yield of garlic during *kharif* (2016-17) season. Among different planting methods, dome shape method ( $P_4$ ) was consistently superior for growth parameters with highest plant height (51.10 cm), number of leaves (7.42), leaf area ( $34.85 \text{ dm}^2$ ) during harvesting and was *on par* with BBF method. Whereas, broad base furrow (BBF) method recorded highest fresh weight (19.96 g), dry weight (10.17 g), dry matter accumulation (60.13 g), bulb weight (14.56 g), bulb diameter (14.92 mm), number of cloves (10.62), hundred clove weight (83.89 g), clove size ( $1.05 \text{ cm}^2$ ) and total bulb yield (6.35 t/ha) compared to other methods. Further, planting large clove was noticed to be superior for the plant height (47.55), number of leaves (7.09), leaf area ( $30.89 \text{ dm}^2$ ), fresh weight (17.38 g), dry weight (9.31 g), dry matter accumulation (55.22 g), bulb weight (13.24 g), bulb diameter (12.45 mm), number of cloves (9.73), hundred clove weight (71.18 g), clove size ( $0.86 \text{ cm}^2$ ) and total bulb yield (5.89 t). The interaction effects were found significant for number of leaves, leaf area, fresh weight, dry weight, number of cloves, clove size and bulb yield. However, interaction effects were non-significant for plant height, dry matter accumulation and hundred clove weight. BBF method of planting with large clove ( $>1 \text{ g}$ ) was found to be superior over all the treatments as it resulted in better growth and higher yield with highest B:C ratio.

**Keywords:** Garlic, *kharif*, BBF, Dome shape and Yield

### Introduction

Garlic (*Allium sativum L.*) is one of the important and widely consumed bulbous spice crops belonging to the family, *Alliaceae*. The economic yield is obtained from its underground bulb, which consists of bulblets, popularly called as cloves. It contains protein, phosphorus, potash, calcium, magnesium, carbohydrates and a colourless as well as odourless water soluble amino acid called allicin. On crushing the bulb an enzyme allinase acts upon allin and breaks down to produce allicin, the principal ingredient of which is odoriferous *diallyl-disulphide*, which is the major flavoring component in garlic. Land configuration (flat bed, broad base furrow, ridges and furrows and dome shape) also plays a major role in increasing the productivity of garlic. The raised bed zone of broad base furrow system was better with lower penetration resistance favorable for deeper seed placement and better crop emergence (Jayapaul *et al.*, 1996) [6]. Ridge planting not only improved the yield but also the crop growth as compared to flat bed (Tomar *et al.*, 1996) [13]. The size of the bulbs harvested is directly related to the size of cloves planted. Besides its economic importance and other multiple advantages, productivity of the crop is very low because of inappropriate production technologies such as planting method, clove size, fertilization and pest and disease control. Thus, this research was initiated to address the low productivity of garlic by implementing appropriate planting methods and planting material.

### Material and Methods

The field experiment was conducted at Saidapur Farm, Main Agricultural Research Station, University of Agricultural Sciences, Dharwad, during *kharif* (2016-17) season. The treatment consists of four different planting methods viz., flat bed, broad base furrow, ridges and furrow, dome shape method with three different clove sizes *i.e.*, small ( $<0.75\text{g}$ ), medium ( $0.75\text{-}1\text{g}$ ) and large ( $>1\text{g}$ ). Experiment was laid out in a split plot design with three replications. Individual plot size was 4 m X 2 m. The spacing used was 15 cm X 7.5 cm with a single clove per hill.

**Correspondence**  
**Malashri**  
 Department of Horticulture  
 University of Agricultural Sciences Dharwad, Karnataka, India

To obtain uniform maturity, irrigation was stopped two weeks before harvesting. Nitrogen, phosphorus and potassium were applied in the form of urea, di-ammonium phosphate and muriate of potash, respectively at the rate of 125:62.5:62.5 kg NPK per hectare as per the package of practices. At the time of sowing, half the dose of nitrogen and full dose of phosphorus and potassium were applied as basal dose and mixed thoroughly in the soil. The remaining half dose of nitrogen was top dressed at 30 days after sowing. Bulbs were harvested when the leaves had turned pale green and started falling. Data were collected on plant height, number of leaves per plant, leaf area, fresh weight, dry weight dry matter accumulation, bulb weight, bulb diameter, number of cloves, hundred clove weight, clove size and total bulb yield.

## Results and Discussion

The data revealed that planting method had significant effect on plant height, number of leaves per plant, leaf area, fresh weight, dry weight and dry matter accumulation (Table 1). The plant height (51.10 cm), number of leaves per plant (7.42) and leaf area (34.85 dm<sup>2</sup>) was significantly highest in dome shape method of planting (P<sub>4</sub>) which was *on par* with BBF method. However, BBF method recorded highest fresh weight (19.96 g), dry weight (10.17 g), and dry matter accumulation (60.13 g) whereas; the minimum was recorded in flat bed method of planting. The increase in plant height, leaf number and leaf area with the dome shape method and BBF of planting might be due to the increased turgidity of plant cells which resulted in the expansion of cell wall and manifested in the increased lateral and linear dimensions of leaves. This resulted in the higher photosynthetic rate, higher dry matter accumulation in plant parts, increase in plant height and stem girth, maximum dry matter production, translocation of more and more photosynthates from source to sink and ultimately led to higher bulb yield. These findings were well documented by Singh and Tewari (1998)<sup>[11]</sup>, Patil (1995)<sup>[10]</sup>, Suresh (1997)<sup>[12]</sup> and Khalil *et al.* (2002)<sup>[7]</sup> in garlic. The results also revealed a significant influence of size of planting material on plant height, number of leaves, leaf area, fresh weight, dry weight and dry matter accumulation. Planting large clove (>1 g) resulted in maximum plant height (47.55 cm), number of leaves per plant (7.09), leaf area (30.89 dm<sup>2</sup>), fresh weight (17.38 g), dry weight (9.31 g) and dry matter accumulation (55.22 g) followed by medium clove *i.e.*, 0.75-1g. While, the minimum was recorded in small clove. The increase in all these morphological characters due to mobilization of the greater quantities of reserve food materials present in the large sized cloves, resulting in the speedy and increased vegetative growth compared to the small sized cloves. This was in agreement with the results reported by Ahmed *et al.* (2007)<sup>[11]</sup> and Castellanos *et al.* (2004)<sup>[2]</sup>. The interaction effect was found non significant difference for plant height and dry matter accumulation. While, Planting in dome shape method with large cloves (P<sub>4</sub>S<sub>3</sub>) was noticed to be significantly maximum number of leaves per plant (10.83), leaf area (82.22 dm<sup>2</sup>) however, planting in BBF method with

large clove recorded highest fresh weight (23.67 g) and dry weight (13.90 g) while, the minimum was recorded in flat bed with small clove (P<sub>1</sub>S<sub>1</sub>).

The different planting methods also revealed significant differences for yield parameters (Table 2) wherein BBF method of planting (P<sub>2</sub>) resulted in significantly higher bulb weight (14.56 g), bulb diameter (14.92 mm) number of cloves (10.62), hundred clove weight (83.89 g), clove size (1.05 cm<sup>2</sup>) and bulb yield (6.35 t/ha) followed by dome shape method. Lowest was recorded in flat bed method. The increase in yield parameters with the broad base furrow method of planting is attributed to increased dry matter production which in turn was responsible for the translocation of photosynthates from source to sink producing parts. Thus, due to higher photosynthates the bulb characters might have developed to the maximum extent and resulted in higher bulb yields. These findings are in consonance with the reports of Gethe *et al.* (2006)<sup>[4]</sup> in onion, Maheriya (2008)<sup>[9]</sup> in radish and Ingle *et al.* (2000)<sup>[5]</sup> in garlic. The size of planting material also showed significant differences in yield attributes wherein planting large clove (>1 g) resulted in higher bulb weight (13.24 g), bulb diameter (12.45 g), number of cloves (9.73), hundred clove weight 71.18 g, clove size (0.86 cm<sup>2</sup>) and bulb yield (5.89 t/ha) followed by medium clove *i.e.*, 0.75-1 g. The increase in the bulb yield is mainly attributed to production of more number of leaves, higher leaf area, dry matter accumulation, bulb weight and bulb diameter increased significantly by planting large sized clove and further these treatments recorded significantly higher yield which indicated that these parameters had direct influence on yield potential. Similar trend was observed by Deka and Shadeque (1993)<sup>[3]</sup>. The interaction effects were found non significant for hundred clove weight. While, Planting in BBF method with large cloves (P<sub>2</sub>S<sub>3</sub>) was noticed to be superior in terms of bulb weight (18.20 g), bulb diameter (46.86 mm), number of cloves (30.33), clove size (1.92 cm<sup>2</sup>) and total bulb yield (10.82 t/ha).

The data on economics of garlic presented in Table 3. The BBF method with large clove (T<sub>6</sub>) recorded the highest gross return (₹4,13,600/ha.) with highest net returns (₹3,21,395.5/ha.) and recorded the highest cost benefit ratio(3.49:1) followed by BBF method with medium clove(T<sub>5</sub>) with the gross return (₹3,74,800/ha.) with the net returns (₹2,86,595.5/ha.) and cost benefit ratio (3.25:1). This clearly indicates that the BBF method with large clove was found to be technically feasible and economically viable. A similar trend was observed by Lallen *et al.* (1992)<sup>[8]</sup> and Castellanos *et al.* (2004)<sup>[2]</sup> in garlic.

## Conclusion

BBF method of planting with large clove (>1 g) was found superior over all the treatments as it resulted in better growth and higher yield. In the light of the results obtained in the present investigation it could be concluded that garlic cultivation in broad base furrow method of planting with large clove is ideal for getting higher yield, gross and net returns.

**Table 1:** Plant height, number of leaves, leaf area, fresh weight, dry weight and dry matter accumulation of garlic as influenced by planting methods and clove size

Particulars	Plant height (cm)	Number of leaves	Leaf area (dm <sup>2</sup> )	Fresh weight(g)	Dry weight(g)	Dry matter accumulation(g)
<b>Planting methods</b>						
P <sub>1</sub>	38.20	4.59	10.92	12.58	7.37	42.41
P <sub>2</sub>	47.96	6.80	28.87	19.96	10.17	60.13
P <sub>3</sub>	39.56	5.34	16.32	15.27	8.10	52.34

P <sub>4</sub>	49.01	7.42	34.85	16.74	8.86	55.96
S.Em ±	0.84	0.21	2.07	0.41	0.23	0.90
C.D. at 5%	2.53	0.63	6.21	1.22	0.70	2.69
<b>Clove size</b>						
S <sub>1</sub>	42.53	5.19	16.48	15.09	8.11	50.29
S <sub>2</sub>	45.04	5.83	20.85	15.93	8.45	52.60
S <sub>3</sub>	47.55	7.09	30.89	17.38	9.31	55.22
S.Em ±	0.79	0.12	0.81	0.30	0.18	0.89
C.D. at 5%	2.44	0.37	2.49	0.91	0.54	2.76
<b>Interaction</b>						
P <sub>1</sub> S <sub>1</sub>	35.68	4.30	8.86	11.60	6.59	39.18
P <sub>1</sub> S <sub>2</sub>	39.09	4.44	10.38	12.71	7.67	42.94
P <sub>1</sub> S <sub>3</sub>	39.82	5.02	13.52	13.41	7.86	45.10
P <sub>2</sub> S <sub>1</sub>	44.57	5.58	19.64	18.14	9.14	57.48
P <sub>2</sub> S <sub>2</sub>	48.33	6.37	24.73	18.75	9.32	60.33
P <sub>2</sub> S <sub>3</sub>	50.97	8.44	42.23	22.99	12.04	62.57
P <sub>3</sub> S <sub>1</sub>	40.37	4.77	13.26	14.50	7.97	50.23
P <sub>3</sub> S <sub>2</sub>	42.27	5.23	15.65	15.35	8.01	52.13
P <sub>3</sub> S <sub>3</sub>	46.08	6.03	20.04	15.96	8.33	54.65
P <sub>4</sub> S <sub>1</sub>	49.50	6.09	24.18	16.12	8.75	54.28
P <sub>4</sub> S <sub>2</sub>	50.47	7.28	32.63	16.93	8.80	55.02
P <sub>4</sub> S <sub>3</sub>	53.33	8.88	47.76	17.17	9.01	58.57
S.Em ±	0.90	0.56	5.24	1.04	0.74	0.66
C.D. at 5%	NS	1.69	15.90	3.16	2.25	NS

P<sub>1</sub>: Flat bed methodS<sub>1</sub>: Small clove (< 0.75 g)P<sub>2</sub>: BBF methodS<sub>2</sub>: Medium clove (0.75 to 1.0 g)P<sub>3</sub>: Ridges and furrow methodS<sub>3</sub>: Large clove (> 1.0 g)P<sub>4</sub>: Dome shape method**Table 2:** Bulb weight, bulb diameter, number of cloves, 100 clove weight, clove size and yield of garlic as influenced by planting methods and clove size

Particulars	Bulb weight (g)	Bulb diameter (mm)	Number of cloves/bulb	100 clove weight(g)	Clove size (cm <sup>2</sup> )	Yield (t/ha)
<b>Planting methods</b>						
P <sub>1</sub>	9.32	6.39	6.20	45.01	0.53	4.41
P <sub>2</sub>	14.56	14.92	10.62	83.89	1.05	6.35
P <sub>3</sub>	11.88	7.05	6.63	54.00	0.61	5.13
P <sub>4</sub>	12.89	9.97	7.45	70.56	0.86	5.65
S.Em ±	0.17	0.52	0.36	1.66	0.04	0.20
C.D. at 5%	0.52	1.56	1.09	4.98	0.12	0.61
<b>Clove size</b>						
S <sub>1</sub>	11.31	7.56	6.41	56.08	0.71	5.01
S <sub>2</sub>	11.93	8.74	7.04	62.83	0.71	5.25
S <sub>3</sub>	13.24	12.45	9.73	71.18	0.86	5.89
S.Em ±	0.21	0.33	0.23	1.92	0.04	0.09
C.D. at 5%	0.64	1.02	0.71	5.91	0.12	0.27
<b>Interaction</b>						
P <sub>1</sub> S <sub>1</sub>	7.76	4.11	5.36	36.33	0.34	4.05
P <sub>1</sub> S <sub>2</sub>	8.75	4.86	5.94	45.67	0.56	4.39
P <sub>1</sub> S <sub>3</sub>	11.44	10.21	7.31	53.03	0.68	4.78
P <sub>2</sub> S <sub>1</sub>	13.66	12.08	7.60	76.33	0.96	5.91
P <sub>2</sub> S <sub>2</sub>	14.04	14.18	8.81	84.00	1.08	6.25
P <sub>2</sub> S <sub>3</sub>	15.97	18.50	15.45	91.33	1.11	6.89
P <sub>3</sub> S <sub>1</sub>	11.21	5.66	6.00	48.33	0.77	4.98
P <sub>3</sub> S <sub>2</sub>	12.02	7.01	6.31	52.33	0.34	5.06
P <sub>3</sub> S <sub>3</sub>	12.42	8.49	7.58	61.33	0.71	5.34
P <sub>4</sub> S <sub>1</sub>	12.62	8.39	6.68	63.33	0.77	5.11
P <sub>4</sub> S <sub>2</sub>	12.92	8.90	7.11	69.33	0.86	5.30
P <sub>4</sub> S <sub>3</sub>	13.14	12.61	8.57	79.00	0.94	6.53
S.Em ±	0.76	1.00	1.65	1.23	0.15	0.26
C.D. at 5%	2.30	3.04	4.99	NS	0.45	0.78

P<sub>1</sub>: Flat bed methodS<sub>1</sub>: Small clove (< 0.75 g)P<sub>2</sub>: BBF methodS<sub>2</sub>: Medium clove (0.75 to 1.0 g)P<sub>3</sub>: Ridges and furrow methodS<sub>3</sub>: Large clove (> 1.0 g)P<sub>4</sub>: Dome shape method

**Table 3:** Economics of garlic as influenced by plantings methods and clove size

Kharif season					
Treatments	Cost of cultivation (₹/ha)	Yield (t/ha)	Gross income (₹/ha)	Net returns (₹/ha)	B:C ratio
T <sub>1</sub>	83732.5	4.05	243000	159267.5	1.90
T <sub>2</sub>	87732.5	4.39	263600	175867.5	2.00
T <sub>3</sub>	91732.5	4.78	287000	195267.5	2.13
T <sub>4</sub>	83204.5	5.91	354600	271395.5	3.20
T <sub>5</sub>	88204.5	6.25	374800	286595.5	3.25
T <sub>6</sub>	92204.5	6.89	413600	321395.5	3.49
T <sub>7</sub>	83968.5	4.98	298600	214631.5	2.56
T <sub>8</sub>	87968.5	5.06	303800	215831.5	2.45
T <sub>9</sub>	91968.5	5.34	320200	228231.5	2.48
T <sub>10</sub>	84440.5	5.11	306600	222159.5	2.63
T <sub>11</sub>	88440.5	5.30	318000	229559.5	2.60
T <sub>12</sub>	92440.5	6.53	391600	299159.5	3.24

T<sub>1</sub>: Flat bed method + Small clove  
T<sub>3</sub>: Flat bed method + Large clove  
T<sub>5</sub>: BBF method+ Medium clove  
T<sub>7</sub>: Ridges and furrow method + Small clove  
T<sub>9</sub>: Ridges and furrow method+ Large clove  
T<sub>11</sub>: Dome shape method + Medium clove

T<sub>2</sub>: Flat bed method + Medium clove  
T<sub>4</sub>: BBF method+ Small clove  
T<sub>6</sub>: BBF method+ Large clove  
T<sub>8</sub>: Ridges and furrow +Medium clove  
T<sub>10</sub>: Dome shape method + Small clove  
T<sub>12</sub>: Dome shape method + Large clove

## References

- Ahmed HG, Magaji MD, Yakuva AI, Aliyu L, Singh A. Response of garlic (*Allium sativum* L.) to irrigation interval and clove size in semi-arid, Nigeria. J Plant Sci. 2007; 2(2):202-208.
- Castellanos JZ, Vargas P, Tapia, Ojodeagua JL, Hoyos G. Garlic productivity and profitability as affected by seed clove size, planting density and planting method. Hort. Sci. 2004; 39(6):1272-1277.
- Deka BC, Shadque A. Interaction effect of spacing, mulching and clove size on growth and yield of garlic (*Allium sativum* L.) South Indian Hort. 1993; 41(3):159-161.
- Gethe RM, Pawar VS, Pathan SH, Sonawane DA, Kadlag AD. Influence of planting layouts, irrigation regimes and fertilizers level on growth and yield of onion under micro-sprinkler. J. Maharashtra Agric. Univ. 2006; 31(3):272-247.
- Ingle MB, Diware DV, Dod VN. Quality and bulb yield of garlic as influenced by planting methods and spacing. Crop Res. 2000; 20(1):160-162.
- Jayapaul P, Kumar B, Devasagayam M, Panlan BJ, Palchan A, Balkrishnan A. Effect of land configuration methods, irrigation regimes, soil moisture conservation and amendments on soybean yield and quality characteristic. Crop Res. 1996; 10(3):253-257.
- Khalil FA, El-Hamid ASA, Mohamed EI, Hassan MAM. Response of onion crop var. Shandawee 1 to some sources of organic fertilizers. Assiut J. Agril. Scie. 2002; 33(5):73-83.
- Lallen S, Chauhan KPS, Singh JB, Singh L. Effect of method of planting and size of cloves on yield and quality of garlic. Associated Agricultural Development Foundation, India. Newsletter. 1992; 12(2):7-8.
- Maheriya PA. Effect of land configuration and integrated nutrient management of growth, yield and quality of radish (*Raphanus sativus* L.) cv. Pusa Chetki. *M.Sc. Thesis*, Navsari Agricultural University (GAU), Navsari, 2008.
- Patil MP. Integrated nutrient management in commercial vegetables. *M.Sc. (Agri.) Thesis*, University of Agricultural Sciences, Dharwad, 1995.
- Singh JR, Tewari J. Effects of sources of organic manures and levels of nitrogen on growth characteristics of Garlic (*Allium sativum* L.). Indian. J. Hort. 1998; 25:191-195.
- Suresh MJ. Growth, yield and quality of garlic (*Allium sativum* L.) as influenced by spacing and manures. *M.Sc. (Agri.) Thesis*, University of Agricultural Sciences, Dharwad, 1997.
- Tomar SS, Tembe GP. Improvement of physical conditions of black soils in Madhya Pradesh. Technical Bulletin, Department of Agril. Chem. and Soil Science, JNKVV, Jabalpur, 1996, 48-65.